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Bureau voor de Industriële Eigendom

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ten name van:

SKF ENGINEERING & RESEARCH SERVICES B.V.

te Nieuwegein

een aanvraag om octrooi werd ingediend voor:

"Actuator having compact gear reduction",

en dat de hieraan gehechte stukken overeenstemmen met de oorspronkelijk ingediende stukken.

Rijswijk, 12 mei 2000.

De Directeur van het Bureau voor de Industriële Eigendom,
voor deze,

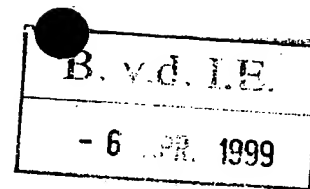
A.W. v.d. Kruk.

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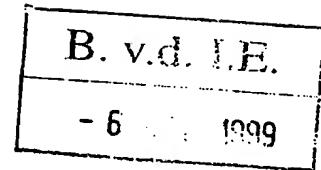
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Abstract



An actuator comprises a housing which contains a motor and a screw mechanism, said screw mechanism comprising a screw and a nut one of which is rotatably supported
5 with respect to the housing, and a gear reduction mechanism connecting the rotor of the motor to the rotatable screw or nut. The gear reduction mechanism comprises at least a concentric gear ring with radially inwardly directed teeth, an excentrically positioned gear wheel having radially outwardly directed teeth wherein the outer diameter of the gear
10 wheel is smaller than the inner diameter of the gear ring, such that the teeth of said gear wheel and gear ring engage each other along a part of their circumferences, and at an opposite part of their circumferences are out of engagement, said excentric gear wheel being rotatable accommodated on an exentric hub which is connected to the rotor of the motor.



Actuator having compact gear reduction

The invention is related to an actuator, comprising a housing which contains a motor and a screw mechanism, said screw mechanism comprising a screw and a nut one of which is rotatably supported with respect to the housing, and a gear reduction mechanism connecting the rotor of the motor to the rotatable screw or nut.

Such actuator is generally known, and can be applied for various purposes such as for actuating a brake, a clutch etcetera. In many of these applications, it is desirable to have a large reduction between the motor and the object, to be actuated, such as brake pads. On the other hand, overall dimensions and weight should remain limited.

The screw mechanism itself provides a reduction which i.a. depends on the pitch of the threads. A small pitch however entails rather narrow threads, which in particular for ball screws would lead to small, vulnerable balls which moreover are difficult to handle.

The gear reduction means therefore preferably should provide a relatively large reduction, such that the screw mechanism can have coarser threads which provide a lower reduction of said screw mechanism itself.

In this respect, the prior art gear reduction mechanisms are not adequate. They comprises a ring gear, satellite wheels and a crown gear. Usually, two or more of these mechanisms are arranged in series so as to obtain the required reduction. The overall dimensions and weight are high.

The object of the invention is therefore to provide an actuator having a gear reduction means with a large reduction, and with relatively small dimensions and low weight. This object is achieved in that the gear reduction mechanism comprises at least a concentric gear ring with radially inwardly directed teeth, an excentrically positioned gear wheel having radially outwardly directed teeth wherein the outer diameter of the gear wheel is smaller than the inner diameter of the gear ring, such that the teeth of said gear wheel and gear ring engage each other along a part of their circumferences, and at an opposite part of their circumferences are out of engagement, said gear wheel being rotatable accommodated on an exentric hub which is connected to the rotor of the motor.

The reduction gear means according to the invention provides a large reduction as a result of the exentric position of the gear wheel and hub. Its dimensions are small in

thickness direction, leading to a compact embodiment.

Preferably, the gear ring is integrated with the screw of the screw mechanism, said screw being rotatably supported with relation to the housing.

Furthermore, a very compact actuator is obtained in case the rotor of the motor is
5 rotatably supported on the outer ring of a support bearing, said outer ring being integrated with the screw and the gear ring.

By means of a radially inwardly extending flange, the rotor may be connected to the exentric hub.

Also, a positive back-drive mechanism is connected to the flange and the
10 housing.

The actuator may be assembled from several sub assemblies such as a housing module, an actuator module and a gear reduction module.

The invention will be explained further with reference to an embodiment shown in the figures.

15 Figure 1 shows a longitudinal section of a brake calliper comprising an actuator according to the invention.

Figure 2 shows a cross-section according to II.- II of figure 1.

The actuator according to the invention comprises a housing 1, containing an electric motor 2, a gear reduction mechanism 4 and a screw mechanism 3. The housing
20 at its one end comprises an external screwthread 5, by means of which the actuator can be connected to e.g. a brake calliper in the case of a disc brake application.

The stator 6 of the motor 2 is connected to the housing 1, the rotor 7 of the motor is supported on a sleeve 8. This sleeve 8, by means of ball bearings 9, is in turn supported with respect to the outer ring 10 of a bearing 11. The inner ring 12 of said
25 bearing 11 is supported on a central support shaft 13, connected to the housing 1.

The central support shaft 13 engages the housing 1 through a load cell 15, and is snapfitted by means of clipring 43 accommodated in the groove 44 of the inner ring 12.

The outer ring 10 of the bearing 11 is integrated with screw 16 of screw mechanism 3. This screw 16 is thus rotatably supported with respect to the housing 1.
30 The nut 17 of the screw mechanism 4 is slidably, but not rotatably with respect to the housing. Through the screwthreads 18, 19 and balls 20, the rotary motion of the screw 16 is converted into a linear motion of the nut 17, which is contained in a cylinder space 32 in the housing 1.

According to the invention, the rotor 7 and the sleeve 8 carry an inwardly directed flange 21, which carries an exentric hub 23.

The exentric hub 23 rotatably supports a gear wheel 24 through bearing 30, the outer teeth of which gear wheel 24 engage the inwardly directed teeth of the ring gear
5 25.

The outer diameter of the gear wheel 24 is smaller than the internal diameter of the gear ring 25, such that over certain distance the circumferences of these gear members engage each other. At the opposite circumferential parts, they are not in engagement, which means that the gear 24 is able to exentrically rotate with respect to
10 the gear ring 25.

In this manner, a great reduction of the rotations of the rotor 7 is obtained.

Claims

1. Actuator, comprising a housing (1) which contains a motor (2) and a screw mechanism (3), said screw mechanism (3) comprising a screw (16) and a nut (17) one of
5 which is rotatably supported with respect to the housing (1), and a gear reduction mechanism (4) connecting the rotor (7) of the motor (2) to the rotatable screw (16) or nut (17), characterized in that the gear reduction mechanism (4) comprises at least a concentric gear ring (25) with radially inwardly directed teeth, an excentrically positioned gear wheel (24) having radially outwardly directed teeth wherein the outer diameter of
10 the gear wheel (24) is smaller than the inner diameter of the gear ring (25), such that the teeth of said gear wheel (24) and gear ring (25) engage each other along a part of their circumferences, and at an opposite part of their circumferences are out of engagement, said excentric gear wheel (24) being rotatable accommodated on an excentric hub (23) which is connected to the rotor (7) of the motor (2).

15

2. Actuator according to claim 1, wherein the gear ring (25) is integrated with the screw (16) of the screw mechanism (3), said screw (16) being rotatably supported with relation to the housing (1).

20 3. Actuator according to claim 1 or 2, wherein the rotor (7) of the motor (2) is rotatably supported on the outer ring (10) of a support bearing (11), said outer ring (10) being integrated with the screw (16) and the gear ring (25).

4. Actuator according to claim 3, wherein the rotor (7) by means of a radially
25 inwardly extending flange (21) is connected to the excentric hub (23).

5. Actuator according to claim 4, wherein a positive back-drive mechanism (30)
is connected to the flange (21) and the housing (1).

30 6. Actuator according to claim 5, wherein the positive back-drive mechanism is a spiral spring (30).

7. Actuator according to any of the preceding claims, wherein the excentric gear

wheel (24) is rotatably supported with respect to the excentric hub (23) by means of a rolling element bearing (30).

8. Actuator according to any of the preceding claims, wherein the motor (2) is an
5 electric motor, the stator (6) of which is connected to the housing (1).

9. Actuator according to any of the preceding claims, wherein the gear reduction
mechanism (4) is at the end of the screw mechanism (3) opposite the end thereof
engaging an actuating means (38) for a brake pad (39).

10

10. Actuator according to any of the preceding claims, wherein the screw (16) of
the screw mechanism (3) is rotatably supported by means of a support bearing (11) with
respect to a central support shaft (13), the gear ring (23) and the gear wheel (24) of the
reduction gear mechanism (4) surrounding said central support shaft (13).

15

11. Actuator according to any of the preceding claims, wherein the screw (16) has
a bore (35) containing a lubricant reservoir (36).

12. Actuator according to any of the preceding claims, wherein the gear reduction
20 mechanism (4) and a positive back-drive mechanism (37) are contained in a gear
reduction module (40).

13. Actuator according to any of the preceding claims, wherein the gear reduction
module (40) comprises a central support shaft (13) for supporting the screw mechanism
25 (3).

14. Actuator according to any of the preceding claims, wherein the screw
mechanism (3), a support bearing (11) for supporting the screw mechanism (3), the rotor
(7) of the motor (2) as well as a bearing (9) for supporting the rotor (7) on the screw
30 mechanism (3) are contained in an actuator module (41).

15. Actuator according to any of the preceding claims, wherein the housing (1),
the stator (6) and electric connections for the motor (2) are contained in a housing

module (42).

16. Brake calliper, comprising a claw piece with at least two brake, and an actuator according to any of the preceding claims.

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fig - 1

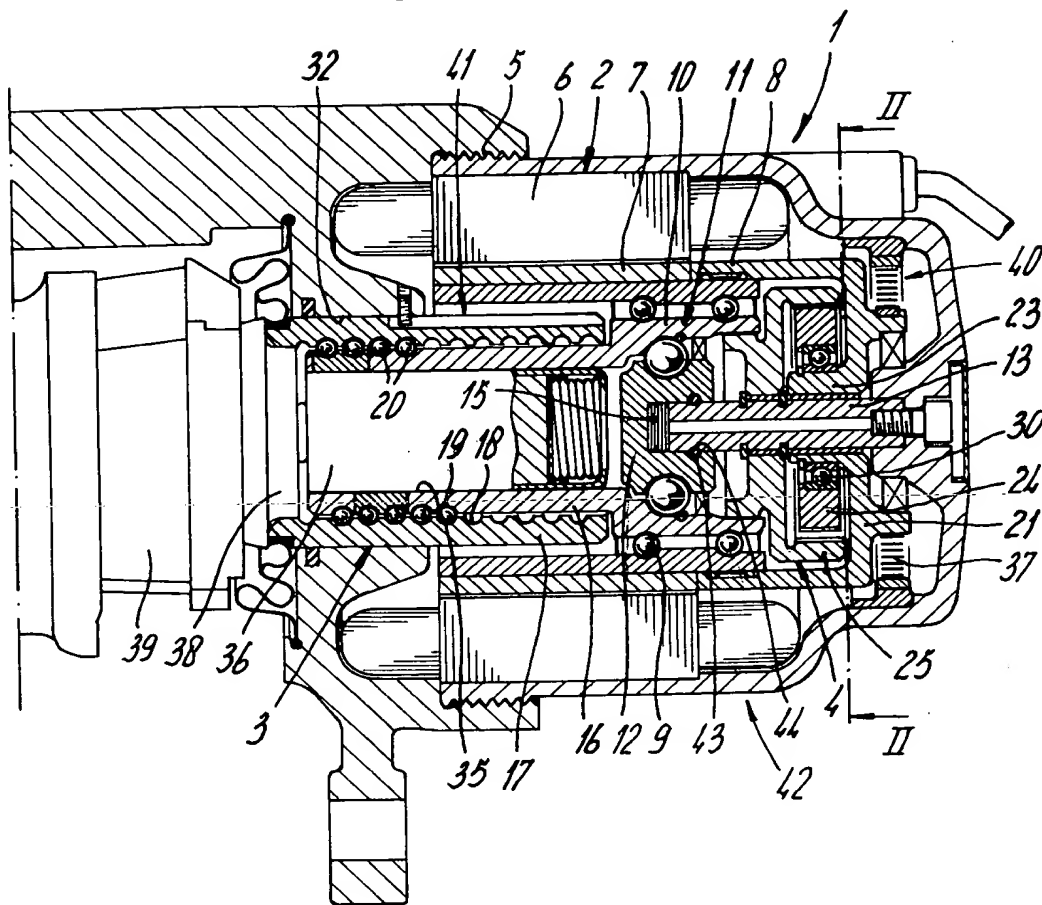
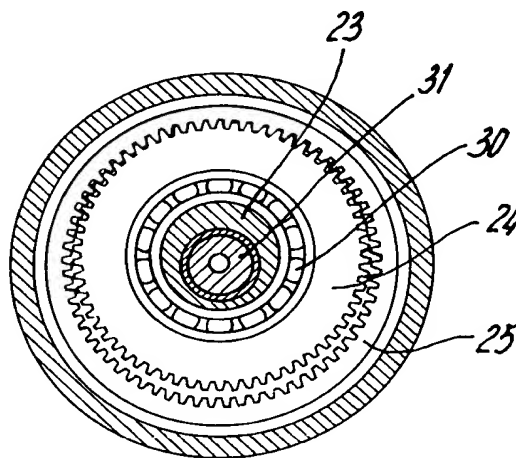


fig - 2



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